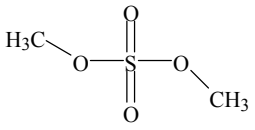
DIMETHYL SULFATE
CAS No. 77-78-1
First Listed in the *Second Annual Report on Carcinogens*



CARCINOGENICITY

Dimethyl sulfate is *reasonably anticipated to be a human carcinogen* based on sufficient evidence of carcinogenicity in experimental animals (IARC V.4, 1974; IARC S.4, 1982; IARC S.7, 1987). When administered by inhalation, dimethyl sulfate induced squamous cell carcinomas of the nasal cavity in rats. When administered by subcutaneous injection, dimethyl sulfate induced local sarcomas in rats. When administered by intravenous injection to pregnant rats, dimethyl sulfate induced tumors of the nervous system in their offspring.

There is inadequate evidence for the carcinogenicity of dimethyl sulfate in humans identified (IARC S.7, 1987). Four cases of bronchial carcinoma were reported in men occupationally exposed to dimethyl sulfate. Additional case reports have since appeared: a case of pulmonary carcinoma in a man exposed for seven years to "small amounts" of dimethyl sulfate but to larger amounts of bis(chloromethyl) ether and chloromethyl methyl ether, and a case of choroidal melanoma in a man exposed for six years to dimethyl sulfate.

PROPERTIES

Dimethyl sulfate is an oily, colorless liquid with a faint, onion-like odor. It is soluble in water, ether, alcohol, dioxane, acetone, and aromatic hydrocarbons and slightly soluble in carbon disulfide and aliphatic hydrocarbons. Dimethyl sulfate is stable at room temperature, and it rapidly hydrolyzes in water. It is flammable when exposed to heat, flame, or oxidizers. Dimethyl sulfate is commercially available as a technical-grade product that contains small amounts of acid impurities.

USE

Dimethyl sulfate is an industrial chemical that is used mainly as an alkylating agent to convert compounds such as phenols, amines, and thiols to the corresponding methyl derivatives (IARC V.4, 1974). It is used in the manufacture of methyl esters, ethers, and amines in dyes, drugs, perfumes, pesticides, phenol derivatives, and other organic chemicals. It is also used as a solvent for the separation of mineral oils and for the analysis of auto fluids (Sittig, 1985). It is also a component of polyurethane-based adhesives. Formerly, diethyl sulfate was used as a war gas (HSDB, 1998).

PRODUCTION

Chemcyclopedia 98 lists five domestic suppliers of dimethyl sulfate and the 1998 Chemical Buyers Directory names six suppliers of the chemical (Rodnan, 1997; Tilton, 1997), a decrease from the 18 suppliers identified for 1989 (Chem Sources, 1990). The 1997 Directory of Chemical Producers cited two domestic producers, one company having two locations, but no volumes were reported (SRIa, 1997). The USITC identified one producer from 1980 to 1988, but production figures were not disclosed (USITC, 1981-1989). Total imports for diethyl and dimethyl sulfate exceeded 1.5 billion lb in 1987 and 1.1 billion lb in 1985 (USDOC Imports, 1988, 1986). The 1979 TSCA Inventory identified four companies that produced 60 million lb of dimethyl sulfate and four companies that imported an unstated volume in 1977. The CBI Aggregate was between 1 million and 100 million lb (TSCA, 1979). No data on exports were available. Dimethyl sulfate was first produced commercially in the United States in 1928 (IARC V.24, 1974).

EXPOSURE

The primary routes of potential human exposure to dimethyl sulfate are inhalation, dermal contact, and ingestion. Potential occupational exposure to dimethyl sulfate may occur at facilities where the chemical is produced or where its derivatives are formulated. The National Occupational Exposure Survey (1981-1983) indicated that 10,483 workers, including 2,456 women, were potentially exposed to dimethyl sulfate (NIOSH, 1984). This estimate was derived from observations of the actual use of the compound (96% of total observations) and the use of tradename products known to contain the compound. In 1979, NIOSH estimated that 4,200 workers were exposed to dimethyl sulfate annually in the workplace (Sittig, 1985). NIOSH reported that 1,250 workers are possibly exposed to dimethyl sulfate, and OSHA estimated possible exposure of 3,900 workers. Dimethyl sulfate enters air and water largely through production losses. The Toxic Chemical Release Inventory (EPA) estimated that 5,796 lb of dimethyl sulfate were released to the environment, specifically to air, from 22 facilities that produced, processed, or used the chemical in the United States in 1996. Emissions from seven of the facilities, each reporting gross air emissions > 100 lb, accounted for 96.2% of the total. One facility, located in Belle, West Virginia, reported emissions exceeding 1,000 lb. Its total air release of 2,404 lb represented 41.5% of the entire release of dimethyl sulfate (TRI96, 1998).

Investigators have found the chemical in wastewater streams and air emissions from plants where it was made or used. Since the hydrolysis of dimethyl sulfate in water is rapid, its transfer from water to air is not likely to occur (Sax, 1987). Potential human exposure to dimethyl sulfate may occur as a result of the presence of trace contaminants in end products that are formulated with it (i.e., perfumes, dyes, pharmaceuticals, and pesticides). Potential exposure may also occur from eating food which has come into contact with packaging containing dimethyl sulfate residues. Dimethyl sulfate has been detected in fly ash and in airborne particulate matter generated by coal burning processes. Therefore, individuals may, in addition, be exposed to the chemical by inhalation of ambient air near such power-generating plants (HSDB, 1998).

REGULATIONS

EPA regulates dimethyl sulfate under the Clean Air Act (CAA), Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Resource Conservation and Recovery Act (RCRA), Superfund Amendments and Reauthorization Act (SARA), and Toxic Substances Control Act (TSCA). The National Emission Standards for Hazardous Air

Pollutants (NESHAP) addresses dimethyl sulfate emissions from processing facilities under CAA. A statutory reportable quantity (RQ) of 100 lb has been established for this chemical under CERCLA. RCRA regulates dimethyl sulfate as a hazardous constituent of waste. Dimethyl sulfate is subject to reporting requirements under RCRA, SARA, and TSCA. Under the Food, Drug, and Cosmetic Act (FD&CA), FDA regulates the chemical as an optional component of polyurethane-based adhesives. Migration of dimethyl sulfate to food is not expected under the conditions of use specified in the adhesive regulation. OSHA revised the 8-hr time-weighted average (TWA) to 0.1 ppm (0.5 mg/m^3) as a limit for dimethyl sulfate in the workplace; this standard was adopted for carcinogenicity. OSHA also regulates dimethyl sulfate under the Hazard Communication Standard and as a chemical hazard in laboratories. Regulations are summarized in Volume II, Table B-54.